PATENT SPECIFICATION

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DRAWINGS ATTACHED

1 286 446

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(54) PLATE HEAT EXCHANGER

(71) We, JOHANNES BURMESTER & Co., a German company of Sandstrasse 31, 2057 Geesthacht, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to plate heat exchangers for heating or refrigerating equipment and more particularly to such equipment arranged to operate at high pressures of the heat conducting fluid, and comprising flow ducts connected in parallel or in series which run parallel to one another between turning points and having flow cross-sections which are increased by increasing the number of ducts, through which the liquid can flow between the turning points.

Heat transfer between the heat carrying fluid and the wall of a plate heat exchanger is dependent to a great extent on the speed of the heat transfer fluid. During the heat exchange process many gases and vapours change their state and thus a change in volume occurs. Thus the volume of heat transfer fluids which are evaporated increases, for instance in the case of dichlorodifluoromethane, chlorodifluoromethane, ammonia, while in the case of vapours which condense, for instance water vapour, there is a decrease in volume.

If heat transfer occurs in an apparatus with a flow path having a constant cross-section (for instance in a tube coil) the change in volume of the heat carrying fluid changes its speed. However, high flow speeds mean that there is a high dynamic resistance in the flow cross-sections. In the case of refrigerating equipment this means that the evaporation temperature at the inlet side of the heat exchanger differs from the temperature of the outlet of the heat exchanger.

The uneven superficial loading is particularly unwelcome in the case of heat exchangers of large size which are made up of plates defining a zig-zag flow path or paths. Plates of this type have up till now only been used in equipment of small dimensions with few flow ducts for cooling rooms, cupboard type refrigerators or used for heating small quantities of air in small spaces. In this case the overall length of the flow ducts has little influence on the evenness of the superficial loading. In the case of these plates two pieces of sheet metal provided with grooves are welded together. Two half grooves form a flow duct for the heat transfer fluid, for instance refrigerating gas with condenses. The flow ducts are connected in the flow direction in series and in the case of large plates give a substantial length of flow.

The consequence is the pressure drop and varying thermal superficial loading. These factors lead, for example in the case of an evaporator, to more ice being formed at the refrigerant inlet than at the outlet.

Plate heat exchangers have been proposed in which an attempt has been made to overcome the above-mentioned disadvantages by the use of a stepped increase in the fluid flow cross-section for the heat transfer fluid. However, the positions at which there is a change in the cross-sectional area were arranged at the turning points of the fluid ducts, so that an even distribution of the heat transfer fluid passing from one duct to another becomes uncertain, and this has a disadvantageous effect on the even flow of the heat transfer fluid in the ducts.

The invention provides a plate heat exchanger comprising means defining parallel flow paths extending between fluid turning points, wherein at the fluid turning points the flow paths are kept separate from each other, and, downstream, of at least some of the fluid turning points, the flow paths are forked in such a way that the total cross-sectional area of flow paths after forking is greater than the cross-sectional area of the flow paths before forking.

Preferably, the cross-sectional diameter of each flow path after forking is the same as that of each flow path before forking.

Preferably, the flow paths run together

[Price 25p]

immediately before forking, the cross-sectional area of the run-together flow paths being at least as great as the total cross-sectional areas of the separate flow paths.

Preferably, the flow paths run together immediately before an outlet of the plate heat exchangers the cross-sectional area of the run-together flow paths being at least as great as the total cross-sectional areas of the separate flow paths.

The accompanying drawings show a preferred embodiment of the present invention as applied to a refrigerating or cooling installation which is shown diagrammatically.

Figure 1 is an embodiment of a plate heat exchanger in a section parallel to two plates provided with grooves.

Figure 2 is a section on the line II—II of Figure 1.

Figure 3 shows a detail of a modification position A of the duct system of the plate heat exchanger in accordance with Figure 1 with a forking and passage from one flow duct into two flow ducts, on a somewhat greater scale.

Figures 4, 5, 6 and 7 are sections on the line IV—IV, V—V, VI—VI, and VII—VII of Figure 3.

Figure 8 shows a detail of a modification position B of the duct system of the plate heat exchanger in accordance with Figure 1 with forked junctions and a passage from two flow ducts to three flow ducts, on a somewhat greater scale.

Figures 9 and 10 are sections on the lines IX—IX and X—X of Figure 8.

Figure 11 shows a detail of a modification position C of the duct system of the plate heat exchanger in accordance with Figure 1 with forked divisions and a junction between three ducts and four ducts, on a somewhat greater scale.

Figure 12 and Figure 13 are sections respectively on the lines XII—XII and XIII—XIII of Figure 11.

In Figure 1 a plate heat exchanger 1 is made up in a known manner, for example as described in German Patent Specifications 1,063,616 and 1,139,136, using two sheet metal plates with suitable grooves. The plates are welded together along lines 3 (Figure 2) between the grooves in order to form a duct system. At an inlet duct 4 the fluid which is to release or take up heat, for example ammonia, water or the like, preferably at a somewhat increased pressure, flows into the duct system which is provided with turning points or positions 5, 6, 7, 8 at the ends of the ducts or flow paths 9.

The ducts 9 extend as far as a modification position A, which downstream of a turning point 10 is provided with a forked division 11 (Figure 3) for transfer from one channel 9 in to two channels or ducts 12 and 13 with turning points 14 and 15 at the ends thereof. A subsequent turning position 16 is in the form of a further modification position B having two forked divisions 17, 18 for a transfer from the two ducts 12, 13 into three such ducts 19, 20 and 21 with turning point 22 and 23 at the ends thereof. A subsequent turning position 24 is in the form of a further modification position C with three forked divisions 25, 26 and 27 to provide a transition of the three ducts or channels 19, 20 and 21 into four ducts 28, 29, 30 and 31 with two turning points 32, 33 at the ends thereof. These four outlet ducts lead into two outlet ducts 34, 35 with forked divisions 36, 37.

All flow ducts or channels have the same cross-section and are defined by the weld seams 3. The whole plate heat exchanger can be made of two metal plates connected together by welds 3.

The forked divisions bring about a satisfactory turbulence of the gaseous phase of the fluid so that the heat exchange is increased. The forked divisions make it possible to influence effectively the flow duct length while maintaining constant the flow cross-section of individual ducts, and pressure losses, while allowing a progressive increase or decrease of the number of parallel flow ducts forming the flowpath at successive zones through the plate heat exchanger.

WHAT WE CLAIM IS:—

1. A plate heat exchanger comprising means defining parallel flow paths extending between fluid turning points, wherein at the fluid turning points the flow paths are kept separate from each other, and, downstream of at least some of the fluid turning points, the flow paths are forked in such a way that the total cross-sectional area of flow paths after forking is greater than the cross-sectional area of the flow paths before forking.

2. A plate heat exchanger as claimed in claim 1, wherein the cross-sectional diameter of each flow path after forking is the same as that of each flow path before forking.

3. A plate heat exchanger as claimed in claim 1 or 2, wherein the flow paths run together immediately before forking, the cross-sectional area of the tun-together flow paths being at least as great as the total cross-sectional areas of the separate flow paths.

4. A plate heat exchanger as claimed in claim 1, 2 or 3, wherein there is only a single flow path at an outlet of the heat exchanger.

5. A plate heat exchanger as claimed in claim 1, 2, 3 or 4, wherein the flow paths run together immediately before an outlet of the plate heat exchangers the cross-sectional area of the run-together flow paths being at least as great as the total cross-

sectional areas of the separate flow paths.

6. A plate heat exchanger as claimed in claim 5, wherein two outlets are provided for the said run-together flow paths.

7. A plate heat exchanger as claimed in any one of the preceding claims, wherein at each forking the number of flow paths is increased by one.

8. A plate heat exchanger substantially as herein described with reference to the accompanying drawings.

JOHANNES BURMESTER & CO.

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1286446 COMPLETE SPECIFICATION

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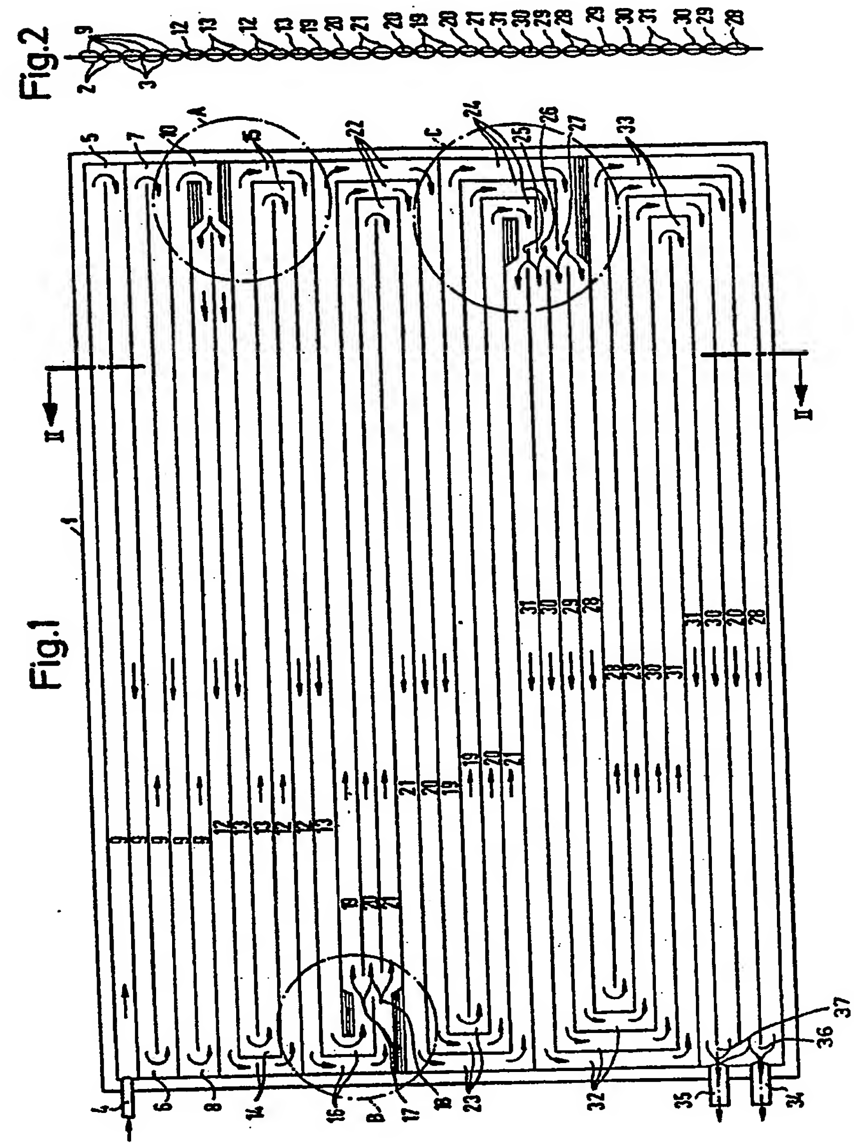

Fig.2

Fig.1

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Sheet 2

Fig.3

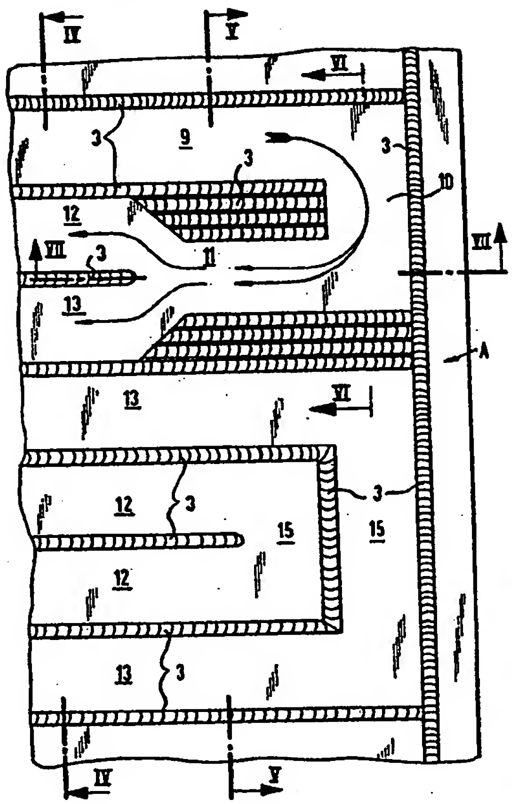


Fig.4

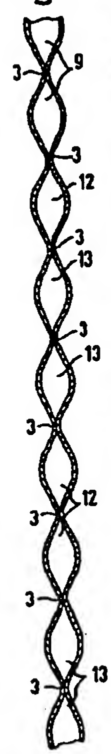


Fig.5

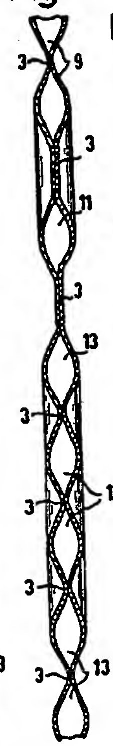
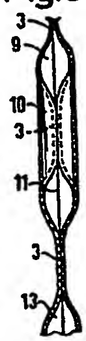


Fig.6



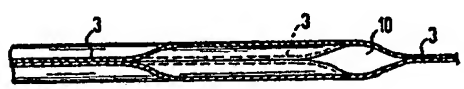


Fig.7

Fig.8

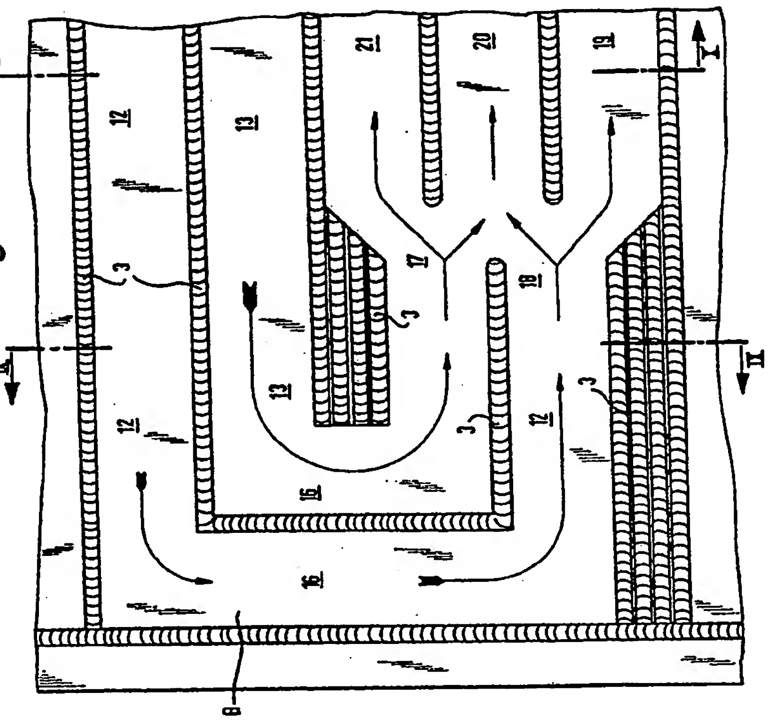


Fig.10

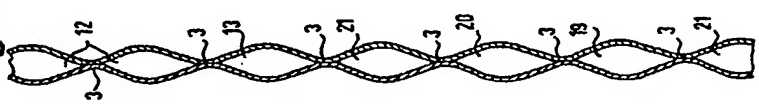
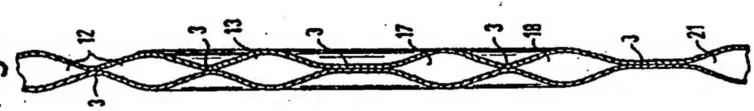


Fig.9



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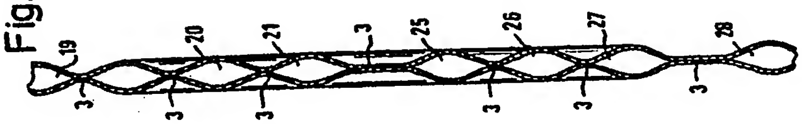
Sheet 4

Fig.13



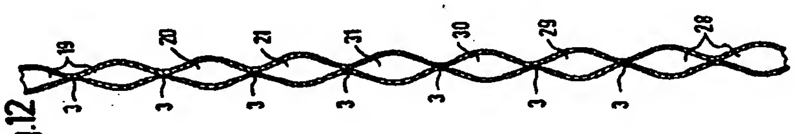


Fig.12

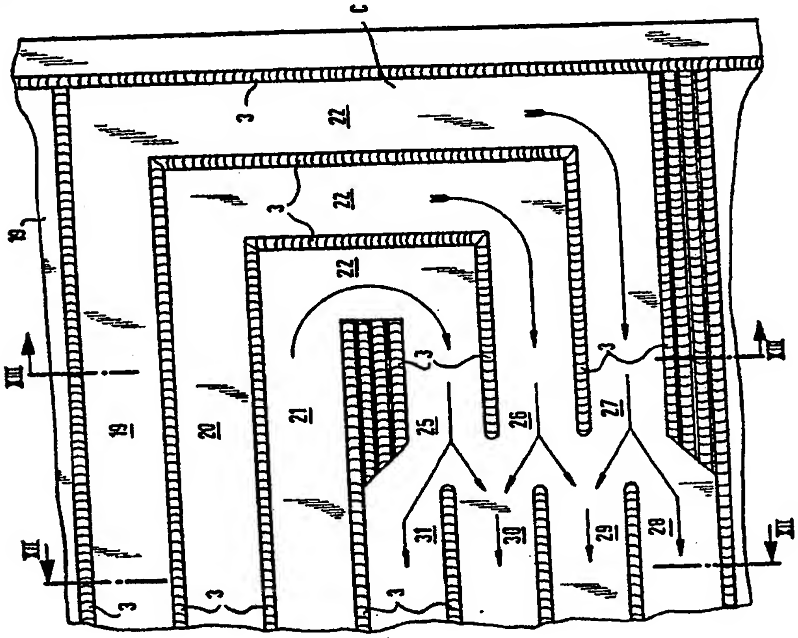


Fig.11